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CUSTOMER NO.: 31561

Application No. 10/064,753

Attorney Docket No.: 09063-US-PA

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Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

The following appeal brief is submitted pursuant the appeal filed on September 19, 2002 in the above-identified application.

I. REAL PARTY IN INTEREST

The real parties in interest are Masato Kawai, Akihiro Nakamura, Masayoshi Hayashida, Yoshinori Watanabe and Shinichi Marumo, the inventors named in the subject application, and Nippon Sanso Corporation, the assignee of record.

II. RELATED APPEALS AND INTERFERENCES

Appellants are not aware of any other appeals or interferences which will directly affect or be directly affected by the Board's decision in the present pending appeal.

III. STATUS OF THE CLAIMS

A total of four claims were presented during prosecution of this application. Claims 1-4 were rejected, from which this appeal is taken.

IV. STATUS OF THE AMENDMENTS

Appellants did not file any Amendment after Final Rejection.

V. SUMMARY OF THE INVENTION

Appellants' invention is directed to a method and an apparatus for producing nitrogen from air using a pressure swing adsorption (PSA) method that uses a specified carbon molecular sieve (CMS) material as an adsorbent. The carbon molecular sieve is characterized

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by that it adsorbs 50% of the saturated oxygen adsorption amount within a period "*TO*" of 5-10 seconds (*TO* = 5-10 sec) starting from the beginning of oxygen supply (Specification, paragraph [0011], lines 13-15), and adsorbs 50% of the saturated nitrogen adsorption amount within a period "*TN*" starting from the beginning of nitrogen supply, wherein *TN* is larger than *TO* in a ratio of more than 41 ($TN/TO > 41$) (Specification, paragraph [0011], lines 15-17; paragraph [0012], lines 15-20). By using the specified CMS in the PSA method, nitrogen of 99%-99.999% purity can be obtained with the regeneration steps of the PSA process being conducted under atmospheric pressure (Specification, paragraphs [0051] and [0052]).

VI. ISSUES

Whether claims 1-4 were improperly rejected under 35 U.S.C. 103(a) on grounds of obviousness.

VII. GROUPING OF THE CLAIMS

For the grounds of rejection contested by Appellants in this appeal, claims 1-4 may be treated as a group. The independent claims 1 and 4 may be taken as representatives for the issues on appeal.

VIII. ARGUMENTS

A. The Related Law

Under the provision of 35 U.S.C. 103(a), the general requirement for non-obviousness of claims is the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

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B. Claims 1-4 Were Improperly Rejected Under 35 U.S.C. 103(a) As Lack of Non-obviousness.

The Office Action holds that claims of Appellants' invention are obvious over the reference teachings as proposed in the Office Action. Appellants respectfully submit that combination of the reference teachings would not have resulted in the invention required by the claims.

In the first Office Action, the Examiner rejected claims 1 and 4 under 35 U.S.C. 103(a) as being unpatentable over Auvil et al. (US 5,240,474) and further rejected claims 2 and 3 under 35 U.S.C. 103(a) as being unpatentable over Auvil et al. in view of Gamba et al. (US 4,925,461). As grounds for the rejections, the Examiner stated that Auvil et al. disclose, in Example 60, a CMS adsorbent having a characteristic time of 15.5 seconds for reaching 2/3 saturation in oxygen adsorption, and Auvil et al. teach that "[t]he nitrogen adsorption time to reach [the same saturation level] is at least 72 times that of oxygen to reach the same saturation level." (First Office Action, at pages 2-3, item 4).

The Examiner then held: "The 50% [oxygen] loading would obviously occur at a time less than 15.5 seconds and would fall within the approximately 5 to 10 seconds" recited in claims 1 and 4 as expected from the characteristic time of 15.5 seconds for reaching 2/3 saturation, and thus claims 1 and 4 are obvious in view of Auvil et al. (First Office Action, at pages 2-3, item 4).

In the April 3, 2003 Response to the first Office Action, Appellants pointed out that Auvil et al. stress that a CMS adsorbent preferably has a high oxygen volumetric capacity for higher recovery and productivity in PSA (Auvil et al., col. 5, lines 2-7). Auvil et al. also teach away from using a CMS adsorbent having an O₂/N₂ kinetic selectivity higher than 41, because the effect of increasing the O₂/N₂ kinetic selectivity from 36 to 72 is small as compared with the effect of increasing the oxygen volumetric capacity by only 50% (Auvil et al., col. 26, lines 6-9). Moreover, the CMS adsorbents mentioned in Examples 58-60 of Auvil et al. are simply theoretical materials for theoretical analyses.

In the Response, Appellants also amended claims 1 and 4 by specifying that a nitrogen purity of 99-99.999% is obtained with the regeneration step being conducted under atmospheric pressure. Appellants further stated that Auvil et al. do not disclose that the CMS in Example 60 can be used to produce a nitrogen product having a purity of 99%-99.999%,

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and Gemba et al. cannot achieve a nitrogen purity up to 99.99% with regeneration steps *under atmospheric pressure*.

With at least the above reasons, it is submitted that independent claims 1 and 4 are not obvious over Auvil et al., and that claims 2 and 3 dependent from claim 1 are non-obvious over Auvil et al. in view of Gemba et al.

In the final Office Action, the Examiner rejected claims 1-4 under 35 U.S.C. 103(a) as being unpatentable over Auvil et al. in view of Gemba et al. As grounds for the rejections, the Examiner firstly repeated the above rejection reasons as in the first Office Action, and then asserted: Example 8 of Gemba et al. shows that the depressurization *down to atmospheric pressure* allow the nitrogen product gas to have "a residual oxygen concentration of 730 ppm", which is approximately 99.9993% pure nitrogen gas." (Final Office Action, at pages 2-3, item 2).

The Examiner then concluded:

One skilled in the art, having both the Auvil et al. ('474) and the Gemba et al. ('461) references before him, would have found it obvious that the PSA process of Auvil et al. ('474), when operated to a depressurization pressure of *atmospheric pressure*, with the particular equalization conditions met, would produce a nitrogen product gas being at least 99.99% purity.

(Final Office Action, at page 4, lines 5-10; Emphasis added). The Examiner thus held that claims 1 and 4 are still obvious over Auvil et al. in view of Gemba et al.

In the July 21, 2003 Response to the final Office Action, Appellants firstly pointed out that there is an obvious calculation error in the Office Action. That is, a residual oxygen concentration of 730ppm should be equivalent to a nitrogen purity of 99.93%, but not 99.9993%. Therefore, the rejection is obviously based on a wrong calculation.

Since the final Office Action failed to response to Appellants' arguments that Auvil et al. do not teach or suggest, or even teach away, to use a CMS adsorbent having the properties disclosed in this invention, Appellants in the Response to the final Office Action stressed again that Auvil et al. are not concerned about the purity of the nitrogen gas product and consider that the oxygen uptake rate and the O_2/N_2 kinetic selectivity are not important. Auvil et al. even teach away from using a CMS adsorbent having an O_2/N_2 kinetic selectivity higher than 41 because the effect of increasing the O_2/N_2 kinetic selectivity from 36 to 72 is

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small as compared with the effect of increasing the oxygen volumetric capacity by only 50%. Moreover, the CMS adsorbents mentioned in Examples 58-60 of Auvil et al. are simply theoretical materials for theoretical analyses. In addition, Auvil et al. do not teach or suggest that the CMS in Example 60 can be used to produce a nitrogen product having a purity of 99%-99.999%. This is also quite reasonable in theory since it is impossible to theoretically estimate the exact purity of a nitrogen gas product from the characteristic values of the CMS adsorbent. With at least the above reasons, Appellants considered that independent claims 1 and 4 and claims 2 and 3 dependent from claim 1 are non-obvious.

However, in the subsequent Advisory Action, the Examiner still rejected claims 1-4 based on the same reasons given in the final Office Action.

Accordingly, the Examiner failed to response to, in both the final Office Action and the Advisory Action, Appellants' arguments that Auvil et al. do not teach or suggest, or even teach away, to use a CMS adsorbent having the properties disclosed in this invention. Though the Examiner did made an argument in the final Office Action against Appellants' response focusing on the purity issue, the only argument is obviously based on a wrong calculation (99.93% \rightarrow 99.9993%). Furthermore, the Examiner ignored the important calculation error in the Advisory Action and still used the same reasons on rejecting claims 1-4, even though Appellants had clearly pointed out the calculation error.

In summary, it is submitted that the CMS adsorbent mentioned in Example 60 of Auvil et al. is merely a theoretical material for theoretical analyses, while the results of the theoretical analyses teach away from using such a CMS adsorbent. In addition, Gemba et al. cannot produce nitrogen of 99.99% purity with regeneration steps being conducted *under atmospheric pressure*, since a residual oxygen concentration of 730ppm is equivalent to a nitrogen purity of 99.93%, but not 99.9993%.

Appellants further submit that one of ordinary skills will not anticipate that using the CMS adsorbent of Example 60 of Auvil et al. can make a nitrogen purity up to 99.999% simply based on the analyses of Auvil et al. Meanwhile, one of ordinary skills cannot predict the purity of the nitrogen gas obtained by using any CMS adsorbent of Auvil et al. based on the experiment results of Gemba et al., since Gemba et al. do not disclose the corresponding characteristic values of the CMS adsorbents used in their experiments and correlation

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between the CMS adsorbents of Auvil et al. and those of Gemba et al. therefore cannot be established.

Accordingly, Appellants assert that independent claims 1 and 4 and dependent claims 2-3 dependent from claim 1 were improperly rejected under 35 U.S.C. 103(a), and respectfully request the Board to cause these rejections to be withdrawn.

IX. CONCLUSION

As noted above, the claimed invention cannot be obtained by combining Auvil et al. and Gemba et al., and is therefore non-obvious over the prior art. As such, Appellants believe that the rejections under 35 U.S.C. 103(a) are in error, and respectfully request the Board of Patent Appeals and Interferences to reverse the Examiner's rejections of the claims on appeal.

Respectfully Submitted,
JIANQ CHYUN Intellectual Property Office

Date: October 27, 2003

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APPENDIX - CLAIMS ON APPEAL

1. A method for producing nitrogen using a pressure swing adsorption (PSA) method with air as a raw material, comprising:

having the air contact with an adsorbent that comprises a carbon molecular sieve selectively adsorbing oxygen to produce nitrogen with a purity ranging from 99% to 99.999% by using the pressure swing adsorption (PSA) method that conducts regeneration of the adsorbent under atmospheric pressure, wherein

a period "TO" needed for the carbon molecular sieve to adsorb an oxygen amount of 50% of a saturated oxygen adsorption amount starting from the beginning of oxygen supply is 5~10 seconds, and a period "TN" needed for the carbon molecular sieve to adsorb a nitrogen amount of 50% of a saturated nitrogen adsorption amount starting from the beginning of nitrogen supply is larger than "TO" by more than 41 times.

2. The method of claim 1, wherein a production rate of the nitrogen product with one ton of adsorbent is higher than $100\text{Nm}^3/\text{h}$ as an oxygen concentration in the nitrogen product is 100ppm, higher than $150\text{Nm}^3/\text{h}$ as the oxygen concentration is 1000ppm, or higher than $250\text{Nm}^3/\text{h}$ as the oxygen concentration is 10000ppm, wherein the oxygen concentration serves as a purity indicator of the nitrogen product.

3. The method of claim 1, wherein a processing rate of the air with one ton of adsorbent is less than $500\text{Nm}^3/\text{h}$ as an oxygen concentration in the nitrogen product is 100ppm, less than $570\text{Nm}^3/\text{h}$ as the oxygen concentration is 1000ppm, or less than $690\text{Nm}^3/\text{h}$ as the oxygen concentration is 10000ppm, wherein the oxygen concentration serves as a purity indicator of the nitrogen product.

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4. An apparatus for producing nitrogen with a purity ranging from 99% to 99.999%

using air as a raw material, comprising:

an air compressor for compressing the air;

a dryer for removing water from the compressed air;

at least one adsorbing column into which the dried and compressed air is conducted, the adsorbing column being filled with an adsorbent that selectively adsorbs oxygen; and

a product tank for temporarily storing a nitrogen product conducted out of the adsorbing column after oxygen is removed in the adsorbing column, wherein

in said at least one adsorbing column, an adsorption step and a depressurization regeneration step are switched alternatively and periodically to implement a pressure swing adsorption (PSA) process, wherein the adsorption step comprises conducting a raw air compressively into the adsorbing column, and the depressurization regeneration step comprises releasing a compressed gas under atmospheric pressure after the adsorption step; and

the adsorbent is a carbon molecular sieve that selectively adsorbs oxygen, which adsorbs an oxygen amount of 50% of a saturated oxygen adsorption amount with a period "TO" of 5~10 seconds starting from the beginning of oxygen supply, and adsorbs a nitrogen amount of 50% of a saturated nitrogen adsorption amount with a period "TN" starting from the beginning of nitrogen supply, wherein TN is larger than TO by more than 41 times.